

FIGURE 6.—Layout of the mezzanine for a poultry wholesaler in a multiple-occupancy building.

**PLANNING
A WHOLESALE POULTRY LAYOUT
IN A
MULTIPLE-OCCUPANCY BUILDING**

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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PLANNING A WHOLESALE POULTRY LAYOUT IN A MULTIPLE-OCCUPANCY BUILDING

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SUMMARY

Poultry wholesalers who will be moving into food distribution centers will want a good layout because it will greatly affect the efficiency of their operation. A good layout can be developed by considering some fundamental principles of layout. These principles can be useful guides in helping the poultry wholesaler determine the most desirable arrangement of rooms, equipment, and work areas for an efficient operation. A good layout will minimize travel distances, congestion, delays, backtracking, rehandling, and interferences while providing for employee safety. Some principles of layout planning are presented in this report, and their application to the layout of a poultry wholesale facility in a multiple-occupancy building is discussed.

In developing a layout, it is best to begin with the overall layout, then proceed to develop the details. A preliminary step in planning the overall layout is to get facts, such as products to be handled, volume, rate of turnover, and functions to be performed. The relationship of functions performed affects the location of various areas within the building. Once the location of each area has been established and visualized, then

the detailed layout of each area can be planned. A detailed layout plan should be developed to show the exact amount of space needed for each operation and the location of work stations and all facilities. The arrangement of equipment, selection of a handling system, and stacking patterns should be considered in determining the exact amount of space needed. When the detailed layout for each area has been developed, the areas must be combined to form the layout of the entire facility. Adjustments may be necessary to fit the areas within the boundaries for the building. After any necessary adjustments have been made, the layout should be evaluated to determine if it satisfies the principles of good layout planning and if it meets the needs of the firm.

To show the wholesaler how to use the principles of layout planning, a step-by-step procedure is used to develop an example of a layout. The layout is designed for a firm that will occupy one "store unit," approximately 3,000 square feet, of a multiple-occupancy building in a food distribution center. The assumed firm in the example is a poultry processor-wholesaler who handles 6.3 million pounds of ice-packed poultry and 200,000 pounds of frozen poultry products annually. Processing consists of cutting up and packaging 2.2 million pounds of poultry per year.

¹ Mr. Kozlowski has transferred from the U.S. Department of Agriculture to the U.S. Navy.

INTRODUCTION

Many poultry wholesalers in urban areas need new facilities because their present ones are obsolete, inadequate, or no longer in the most advantageous location. Some wholesalers are operating in old buildings never intended for handling food, which have structural and space limitations that prevent the firm from using modern handling equipment and methods.

Most of the inadequate buildings are in crowded areas where narrow streets and congested traffic make it difficult and costly to receive and distribute products. Parking space for the employees, customers, and company vehicles is often insufficient or nonexistent. Land for enlarging the facilities is either not available or too costly.

New wholesale food distribution centers have been built in many cities and others are under

construction or being planned. These centers provide facilities that are especially designed for handling food and they permit using modern material handling systems. They also provide expansion areas so that businesses can adjust their space needs for growth and changing operations.

The purpose of this report is to provide information to help a poultry wholesaler lay out the space his firm would occupy in a building in a food center. The information includes a description of buildings in food distribution centers, principles of layout planning, their application to a poultry wholesale firm, a step-by-step procedure for planning a layout, and an example of a layout. This layout is intended to serve as a guide to the poultry wholesaler who will be planning the layout for his firm.

DESCRIPTION OF BUILDINGS IN FOOD DISTRIBUTION CENTERS

Most new wholesale food distribution centers are located in areas other than downtown, where enough land can be obtained in one unit and usually at less cost than in a downtown area. Buildings are designed specifically for handling food with modern materials-handling systems. Streets between the buildings are wide to permit trucks to back up to the building and to reduce congestion. Adequate parking is provided for employees, customers, and trucks (fig. 1).

Two types of buildings are constructed in wholesale food distribution centers. One type is the single-occupancy building that is designed to serve the needs of a single, large wholesale firm. The other type is a multiple-occupancy building that can house several small wholesale firms. This building is divided into uniform-size "store units" placed side by side. Store units discussed in this report are 30 feet wide and 100

feet long, with ceilings at least 20 feet high (fig. 2). Firms are separated by non-load-bearing partitions extending from the floor to the ceiling. If a firm requires more space than one unit provides, that firm can occupy adjoining units. The floor of the building is truck-bed and railcar high. Covered platforms extend along both the front and the rear of each store unit for loading and unloading trucks and railcars and to permit the interchange of products between firms. The front platforms can be enclosed, depending upon the type of food wholesalers who occupy the building. Mezzanines provide space for offices, restrooms, a lunchroom, and packaging material storage.

Before a poultry wholesaler starts to develop a layout plan for his unit, he should become familiar with the fundamentals involved in layout planning. A better plan will result.



FIGURE 1.—New, modern urban food distribution facilities. (Photo courtesy of Philadelphia Fresh Food Terminal Corp., Philadelphia, Pa.)

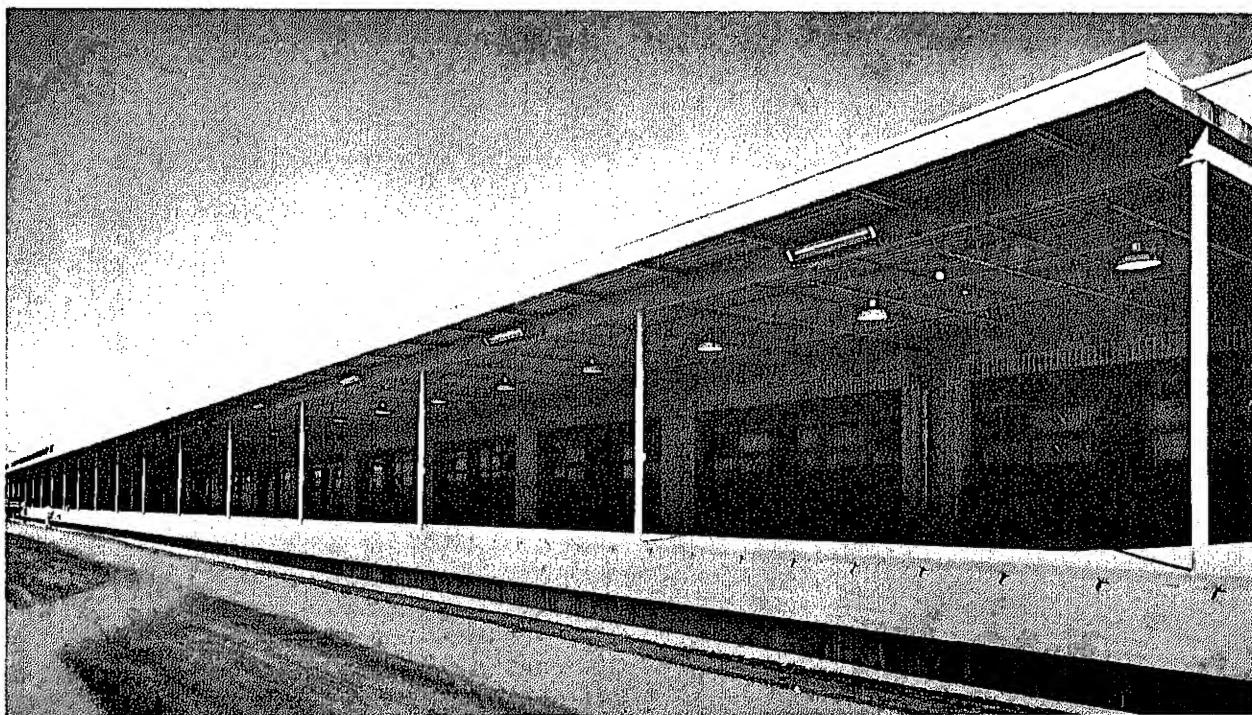


FIGURE 2.—A multiple-occupancy building designed for urban food distributors. The building is divided into units.

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PRINCIPLES OF LAYOUT PLANNING

Developing a good layout can be thought of as arranging equipment, work areas, and other elements of an operation in accordance with good commonsense. Operations are arranged in the order that they occur; travel distances are kept short and direct; congestion, delays, and backtracking, rehandling, and interferences are held to a minimum; safety and protection of employees are built in; nonproductive effort is minimized; and work is distributed as equally as possible among workers.

Fundamental principles that should be considered in developing a good layout are:

- Make good use of space.
- Move men and materials minimum distances.
- Provide for good product flow.
- Plan so that future changes can be made.
- Provide safe, satisfactory, and efficient working conditions.
- Bring together all factors to make a total working unit.

Make Good Use of Space

A wholesale operation should be fitted into the fewest possible number of store units of a multiple-occupancy building to minimize rental charges. If this is not done when the layout is planned, an additional store unit may be required even though only a part of it is needed.

Primary operations (receiving, storing, processing, order assembly, shipping) should be located on the first floor. Secondary operations (offices, restrooms, a lunchroom, and packaging material storage) can be located on a mezzanine.

Products and materials should be stacked as high as possible in storage areas. A 20-foot ceiling permits the high stacking of frozen and chilled products and packaging materials with a palletized handling system. Pallets of products can be stacked in racks three or four tiers high to use cubic space. However, iced poultry usually is stacked only one tier high. If a palletized handling system is not used but, instead, products and materials are handled manually, they should be stacked as high as practical.

Much emphasis should be put on determining

the amount of refrigerated space needed. Refrigerated space is costly to construct and to operate and should not be wasted. Generally, storage rooms should have capacity for only normal volumes handled.

Move Men and Materials Minimum Distances

Moving products within the facility adds nothing to their value but increases their handling costs. Although movement cannot be completely eliminated, the distances and frequencies of movement can be minimized by locating operations that follow one another as close as practical. The location of operations is especially important where men (or products) move frequently between operations and work areas. Transporting the maximum number of packages per trip and reducing the distance traveled reduce the amount of movement.

Provide for Good Product Flow

Locate and arrange work areas, rooms, and equipment so that products flow smoothly from one operation and work area to the next with minimum backtracking, rehandling, or interference. Arrange equipment to provide sufficient space for operation and maintenance. Store products in such a way that they can be moved easily and quickly to and from the storage area. Locate work areas so that there is a good, orderly flow of products from one area to the next.

Plan So That Future Changes Can Be Made

After wholesalers have located in food distribution centers, many of them have experienced sales increases, which often created a need for more space later. Because a store unit is usually bounded by those of other firms, expansion outward is generally impossible unless a vacancy occurs. A need for more space then may force a wholesaler to continue operating with decreasing efficiency when sales exceed the designed capacity of the store unit, or he must relocate. To take care of future needs, plan a layout that

considers the likelihood of sales increases, the addition of new products, and the availability of newly developed equipment.

Future expansion can be provided for in several ways. Permanent structures, such as cooler walls or partitions, should be used only where essential because they limit changes that can be made. The size of refrigerated rooms can be determined on the basis of stacking products, except ice-packed poultry, in racks two tiers high, with aisles 8 feet wide. Space for a third tier can provide for future expansion. Adjustable storage racks can be used so that space is not wasted between pallets of products of different stacking heights. Refrigeration equipment can be installed with capacity to cool a larger volume of products than is first needed. The excess capacity will provide for future expansion of storage space without having to add to existing refrigerator equipment. The operating cost will usually be less because the refrigeration unit will not have to run as often in order to maintain the desired temperature. If two small units are installed instead of one large one, a safety factor is provided in case of mechanical failure.

Provide Safe, Satisfactory, and Efficient Working Conditions

A good layout provides safe, satisfactory, and efficient working conditions for the workers affected by it. Firms that provide and maintain good working conditions can expect to have less labor turnover and absenteeism, higher morale, lower insurance rates, and greater productivity than firms that maintain poor working conditions.

Equipment with moving parts should have guards or covers to protect employees from injury. Forklift trucks can be equipped with overhead guards and load backrests to protect operators during high-stacking operations. Concrete floors that might become slick when wet can be given a nonskid surface such as a broom-swept or a graphite finish.

Restrooms, locker rooms, and lunch areas should be provided for employees. Approximately one toilet for every 15 persons of each sex is adequate.

Employee productivity is influenced by temperature, humidity, and ventilation of work areas. A temperature of 75° F. ($\pm 5^\circ$) and a relative humidity of about 50 percent (± 20 percent) is

desirable for employee comfort.² The ventilation system should supply about 300 cubic feet per minute of fresh air to work areas to make working conditions more desirable.

Adequate lighting contributes to employee safety and helps them perform their assigned tasks more easily. Generally, lighting should be provided as follows:³

	Foot-candles
Storage areas	10-20
Offices	80-70
Processing rooms	¹ 80
Inspection areas	¹ 50
Platforms	20
Restrooms	80

¹ Regulations Governing the Inspection of Poultry and Poultry Products, U.S. Dept. of Agriculture, Consumer and Marketing Service, Washington, D.C. 20250.

Bring Together All Factors to Make a Total Working Unit

Each operational area should be arranged so that it will contribute to developing the best total working unit for the facility. When plans for each area are brought together to develop the total working unit, however, it may be necessary to compromise in order to fit them together. Giving the most consideration to the most important operations usually produces the best total working unit.

A good layout can result in worthwhile savings through:

- Increased output of products.
- Fewer delays.
- Reduced material handling.
- Better use of floorspace.
- Reduced inventory of products in process.
- Improved employee morale, safety, and supervision.
- Less congestion.

² MACPHEE, C. W., ed. American Society of Heating, Refrigerating, and Air Conditioning Engineers Handbook of Fundamentals. p. 128. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., New York, 1967.

³ Lighting estimates are based on the information from: Illuminating Engineering Society Lighting Handbook, 57 pp. Illuminating Engineering Society, Inc., New York, 1966. These estimates should be considered only as guides to specific lighting requirements of individual firms.

PLANNING THE OVERALL LAYOUT

The beginning concept of layout should present a theoretically ideal plan without regard for existing conditions or costs. Later, changes will be made that are caused by partial limitations put on the operation by such factors as the building and costs. When this approach is used, a practical layout is produced.

In developing a layout, begin with the overall layout, then develop the details. Space requirements in relation to the volume of products expected to be handled should be determined. In other words, determine roughly the part of the total space needed for receiving, refrigerated storage, packaging material storage, processing and packing operations, order assembly, and shipping. The overall layout can then be started. After the overall layout is completed and carefully analyzed, details of the layout plan can be developed. These details include actual positioning of men, machines, materials, and supporting activities.

Get the Facts

A preliminary step in developing a layout plan is to get information about the business. The kinds of products handled, the volumes of products, and the operations that will be performed, all affect the amount of space that must be provided in the layout.

Products handled

The kind of products handled will affect the kind of storage needed. Fresh poultry requires cooler storage, whereas frozen poultry products require freezer storage. Consideration must also be given to forecasting the kinds of products expected to be handled in the future. Will the product line be expanded? Will the form of the products change, such as whole fresh chicken to fresh cut-up or frozen?

Volume

The volume of poultry products handled directly affects the layout plan. The handling system and storage requirements are related to the volume of each type of product. Turnover rates for the different items must be considered to de-

termine the average quantity stored and the space needed. Past records of volumes handled, turnover rates,⁴ and seasonal peaks can provide planning guides to take care of future needs.

If records are not available, then the average inventory can be calculated by using the following formula:

$$\frac{\text{Weekly volume sold}}{\text{Number turnovers per week}} = \text{Average inventory}$$

Storage space generally should be planned for the maximum volume normally handled, with allowances made for anticipated short-term increases in sales. Quantities of products above what is the maximum volume normally handled can be stored in public warehouses, usually at a lower cost than if the wholesaler provided the additional space in his own facility.

Receiving

Because most poultry products are received by trucks, the operator must provide for unloading them. Workers and equipment must be available for unloading and storing products rapidly to avoid costly delays and deterioration of perishable products.

Storing

Fresh ice-packed poultry should be stored at a temperature between 32° and 45° F. Frozen products should be held at a temperature lower than 0°. Space should be allocated so that different kinds of products can be held separately in a refrigerated storage room. Errors will be reduced in selecting products for filling orders, and it will be easier to maintain inventory records. Refrigerated space should be utilized as fully as possible. Packaging materials can be stored on a mezzanine.

Processing

To maintain sanitation, the operator must provide a separate room for cutting up and packaging poultry. The room must have space for tables,

⁴Turnover rate for ice-packed poultry is usually three times each week, and for frozen poultry, three or four times each month.

cutters (saws), scales, and conveyors, and an area for temporarily holding the product while it is being processed. Space also is needed for packaging material used in processing.

Order assembly

An area must be provided both for assembling products to fill orders and for arranging orders to load into delivery trucks. If a wholesaler's normal deliveries require several trucks, orders can be assembled ahead of time and returned to storage to await loading later. Trucks can be loaded more quickly because orders assembled for each vehicle can be taken directly from storage. Small orders can be assembled on a four-wheel handtruck just before loading when only one or two trucks are needed. If some customers pick up merchandise at the facility, provisions can be made for assembling the order at the time of pickup.

Shipping

Provisions must be made for loading orders into delivery trucks. Products can be moved either from the order assembly area to the trucks or directly from storage rooms. The platform space provided for multiple-occupancy buildings is adequate for the number of vehicles used by most firms and for their customers who pick up their purchases.

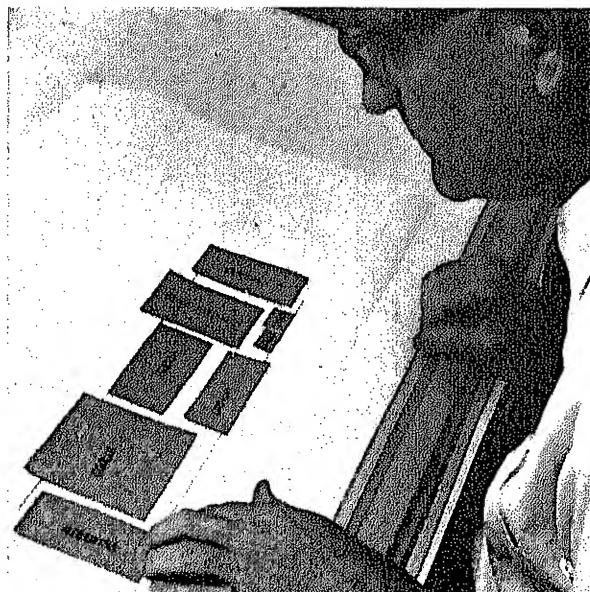
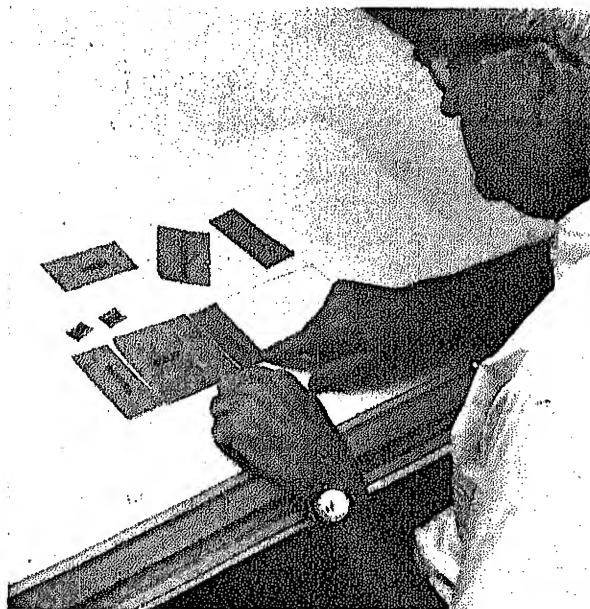
Relationship of Areas

After information is obtained about the products and volumes to be handled and the operations to be performed, the order in which operations are to be performed should be determined (for example, unloading to storage or order assembly). This is the start of actually planning the layout. The relationship of areas is established from the volume moved and the sequence of operations. This sequence reflects the flow pattern. Although the sequence may either be fixed or vary widely, planning usually is based on normal operations.

Visualizing the Layout

To visualize the developing layout, the wholesaler can use several methods that will produce a "picture" of it. Using templates is a practical

method for representing areas or physical objects, such as machinery. Usually templates are two dimensional and made to scale from heavy paper or cardboard. By positioning them on a sheet of paper, various layout schemes can be developed (fig. 3). Adjustments that must be made because of compromises lead finally to the finished layout.



PN-2078, PN-2070

FIGURE 3.—Arranging templates for a layout of a poultry unit.

PLANNING THE DETAILS

Each area must be analyzed to determine the best arrangement. The best arrangement made for an area becomes the detailed layout plan for that area. However, the detailed area plans, along with the layout plans of adjoining areas, must fit into the overall layout plan. A detailed area plan cannot be considered final until its effect on other areas as well as on the overall plan has been analyzed.

Amount of Space

The refrigerated storage area is the heart of the poultry layout because it has the most influence in determining the volume of products that can be handled. Floorspace requirements for stacking boxes of poultry by palletized and manual handling are shown in table 1. Space requirements for packaging materials are similar. The dimensions of the packages and the stacking height determine the amount of floorspace needed. Width of aisles needed throughout the facility can be determined from the guidelines shown in table 2.

TABLE 1.—*Floorspace requirements for stacking boxes of poultry by palletized and manual handling*

Type of handling and height of stacks ¹	Floorspace requirements	
	Per pallet ²	Per ton ³
Palletized: ⁴		
1 tier high	14.00	17.94
2 tiers high	7.00	8.97
3 tiers high	4.66	5.97
Manual:		
7 boxes high (approx- imately 6 feet high).	----	18.24

¹ Ice-packed poultry stacked only one tier high.

² Includes 8 inches of air circulation space at one end of pallets.

³ 1,500 pounds net per pallet assumed.

⁴ Pallets 36 by 48 inches.

TABLE 2.—*Width of aisles needed for passage and work*

Use of aisle	Passage aisle <i>Feet</i>	Work aisle <i>Feet</i>
General forklift truck movement	8	10 to 12
Narrow-aisle forklift truck movement	6	7 to 8
Handtruck movement	5	6
Personnel movement	4	(¹)

¹ Varies with operations performed.

The amount of space needed in the cooler can be determined by multiplying the floorspace requirements per ton (table 1) by the maximum number of tons of poultry the firm expects to store. If the firm stores ice-packed poultry one tier high, 17.94 square feet of floorspace will be needed for each ton. Additional space should be allowed for aisles (table 2). If the firm plans to use a narrow-aisle forklift truck, passage aisles 6 feet wide and work aisles 7 to 8 feet wide will be needed. Aisles should extend through the cooler so that all rows of pallets are accessible.

The same procedure used to determine the space requirements of the cooler can be used to determine the space requirements for the freezer. Some firms that handle small quantities of various frozen products may prefer to store these products on shelves in the freezer. The amount of shelf space required can be estimated by determining the average size and weight of the packages of products.

Space requirements for storage of pallets of packaging material can be estimated by dividing the anticipated inventory of packaging material by the amount that can be stored on a pallet.

The space requirements for the order assembly area should be planned for the maximum amount of products to be assembled at any one time. The size of the order assembly area should be determined from data provided in tables 1 and 2. For example, the space requirements for 10 tons of product stacked one tier high would be 170 square feet (17.94 by 10 feet), plus aisle space.

Adequate space should be allowed in the receiving and shipping areas for unloading and loading of trucks, for a passage and maneuvering area, for transporting equipment, and for storage of pallets.

The size of the processing room should be based on the amount and size of the processing equipment to be used in the room and the amount of product and packaging material temporarily stored there, plus adequate space for employees to work and maneuver. Templates representing the equipment, products, and packaging materials could be used to determine the space requirements.

The amount of space necessary for a trash-room can be determined by the number and size of cans stored. Generally, two or three cans are adequate. A shipping office, located on the first floor, should have space for a standing counter and a stool.

Space requirements for a lunchroom, restrooms, and offices in the store unit should be based upon the furniture and equipment that will be placed in them and the number of people using these areas. Templates of these items are useful in determining the space requirements. The restrooms, lunchrooms, and offices are second-

ary to the operations performed in the facility, so they can be located on the mezzanine in the front of the store unit.

The location of the areas for receiving and shipping are fixed by the design of the multiple-occupancy building.

Planning the Individual Areas

The arrangement of equipment and operations in an area depends somewhat on the arrangement of adjoining areas. The operations performed in one area must be integrated into the operations performed in the adjoining areas. Just as the flow pattern of products, materials, and operations affects the relationship between areas, so it affects the layout within individual areas.

Yet the plans for individual areas are not final until they are integrated into the overall plan made up of the layouts of all the individual areas. When detailed plans of individual areas are brought together, compromises may be necessary to have the best overall plan because products or materials should flow with the least amount of backtracking. The arrangement of individual areas, using the layout principles previously discussed, becomes the detailed layout plan.

MATERIAL HANDLING SYSTEMS

The best material handling system is one that allows movement and storage of products at least cost. No one system is best for all wholesalers because the kind and quantity of products handled and the operations performed differ. A wholesaler has the choice of a handtruck, conveyor, or pallet system for moving his products and materials.

Handtrucks

Two- and four-wheel handtrucks are commonly used for moving small quantities of boxed poultry. Their greatest advantages are their low initial cost and the relatively small amount of floorspace needed to maneuver them. Their greatest disadvantages are the small quantities carried per trip, the manual labor required to move hand-

trucks (a fully loaded, four-wheel handtruck often requires two or three workers to move it), and the worker fatigue. Also, packages must be hand stacked, which limits the use of cubic storage space to a worker's reaching limit of about 7 feet above the floor.

Conveyors

Conveyors can be relatively efficient in some operations. The advantages of conveyors are their low initial cost and few maintenance requirements, and they can be used to move products between floor levels. Their main disadvantages are: Packages must be manually placed on them one by one and removed and stacked the same way; the conveyors must be moved frequently for truck unloading and loading; congestion often

occurs at the ends of the conveyor; cubic space in storage areas cannot be fully used because of the worker's limited reach; the versatility of the conveyors is limited; and they pace the operation, so that employees cannot work any faster than the conveyor moves the product.

Pallets

With a palletized system, the wholesaler can handle a large volume of products at one time. Cubic space can be used by stacking pallet loads of products or materials two, three, or even four tiers high in racks. Trucks can be unloaded or

loaded quickly. Products can be moved with less manual labor than is required with handtrucks.

A palletized system has the disadvantages of higher initial cost than that of handtrucks, greater maintenance requirements, and the need for wider aisles.

Pallets can be moved with a manual transporter, an electric walk-type stacker, or an electric (motorized) ride-type stacker. Prices of such equipment depend on the size, speed, and type chosen. A poultry wholesaler occupying one store unit would likely choose either a manual pallet transporter or an electric walk-type stacker with a 2,000-pound capacity.

EXAMPLE OF LAYOUT PLANNING

To illustrate the use of the principles and procedures of layout planning discussed thus far in this report, an example of a layout is included in this section. The layout is designed for a poultry processor-wholesaler who plans to move into one store unit of a multiple-occupancy building in a food distribution center.

Step 1. Get the facts about operations to be performed.

• Volume of products received annually:		
Ice-packed poultry	-----	6,300,000 pounds
Frozen poultry products	-----	200,000 pounds

Total	-----	6,500,000 pounds
• Turnover rate:		
Ice-packed poultry	-----	150 times per year
Frozen poultry products	-----	40 times per year
• Seasonality of sales—frozen products turnover highest preceding the winter holidays.		
• Volume of poultry processed by wholesaler	-----	2,200,000 pounds
• Forecast of future volume anticipated to be handled in 10 years:		
Ice-packed poultry (20-percent increase)	-----	7,500,000 pounds
Frozen poultry products (20-percent increase)	-----	240,000 pounds

Total	-----	7,800,000 pounds

Step 2. List the major operations to be performed.

- Receiving (unloading)
- Storing in cooler, in freezer, in dry storage
- Processing
- Order assembly
- Shipping (load out)

Step 3. Consider the relationship of each area to the others (refer to step 2).

- Cooler, freezer, and dry storage should be close to receiving (unloading) area.
- Dry storage for packaging materials should be close to order assembly area and processing room.
- Processing room and order assembly area should be near the cooler.
- Processing room should also be near order assembly area.

Step 4. Calculate the approximate volumes of products and materials that move between operations. Then convert the volume values to a percentage of the total handled.

- Operations with high percentages of movement between them should be placed as close together as possible. Operations with low percentages of movements between them need not be placed near each other.
- The percentages of movement can then be used to show the relationships between all operations as illustrated in figure 4.

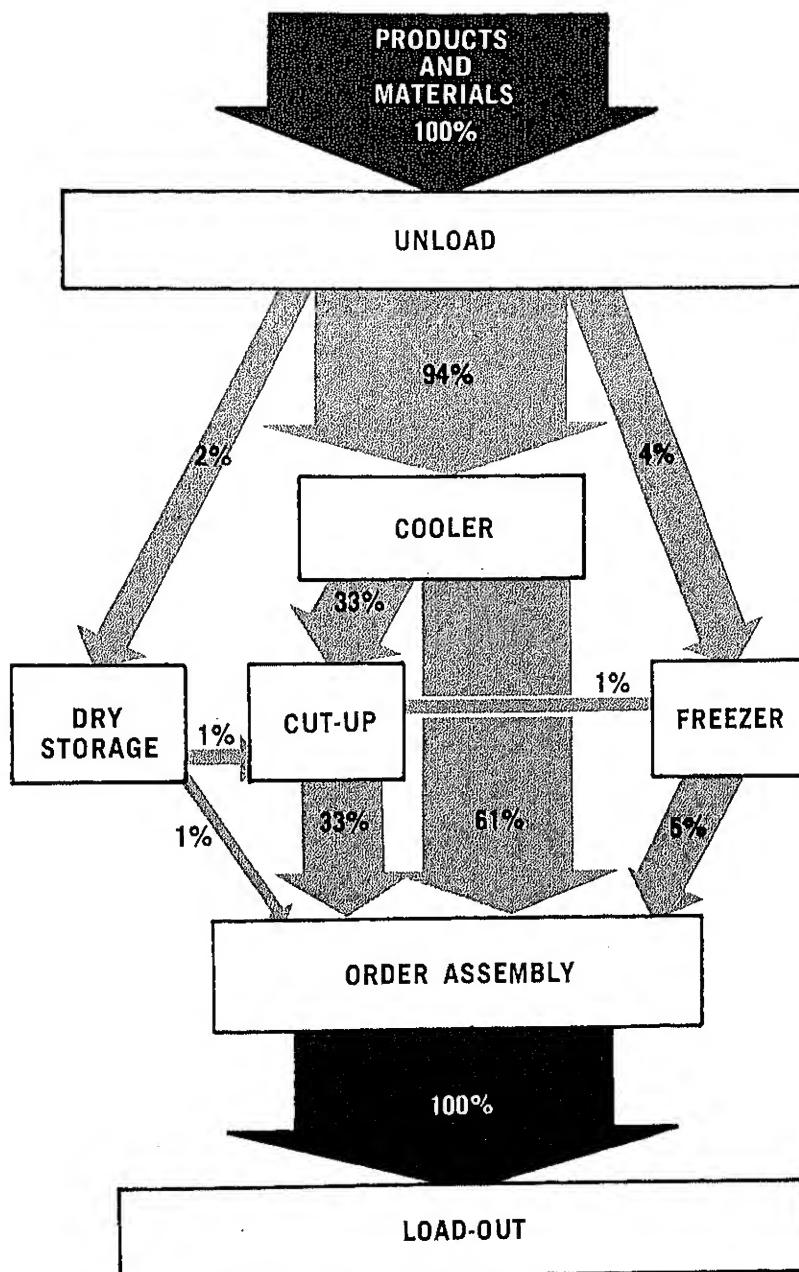
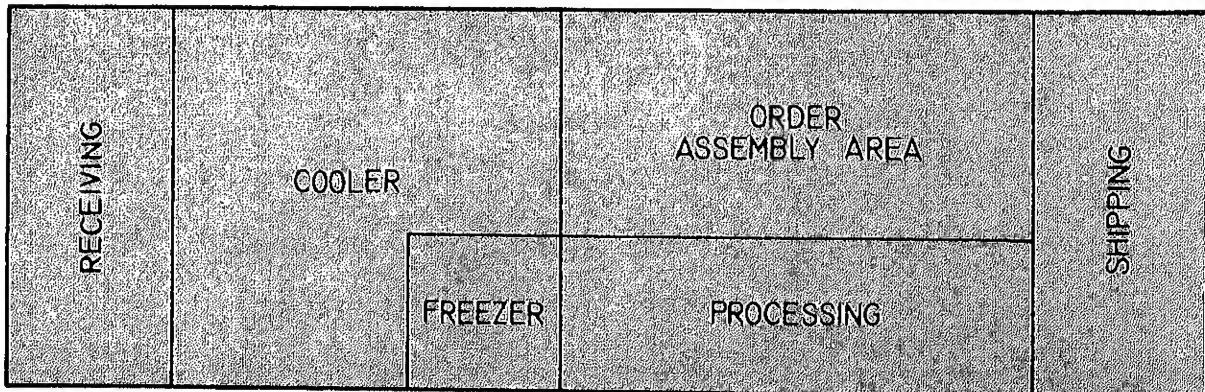


FIGURE 4.—The flow of products and material is shown by the arrows. Width of the arrows represents the percentage relationship of the volumes moving between operations.

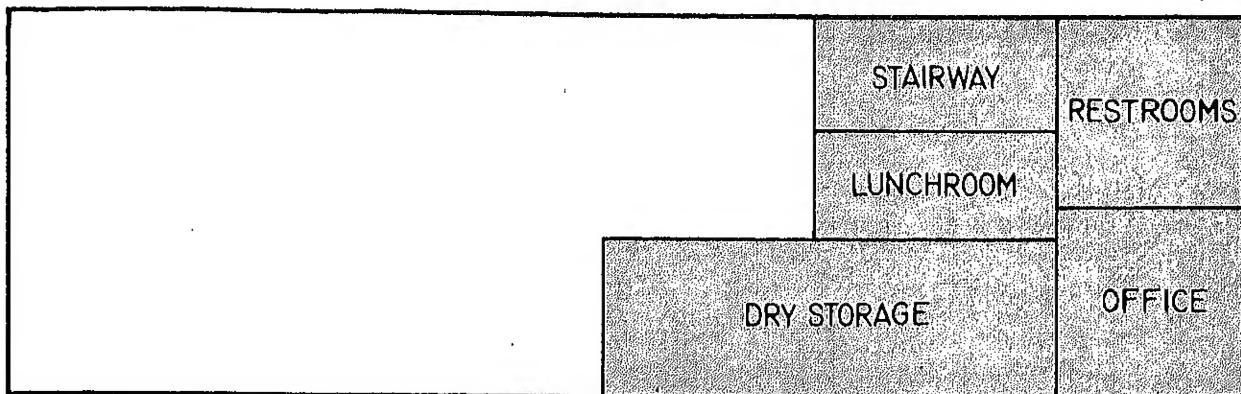
Step 5. Visualize the layout

- Draw to scale on a sheet of paper an outline of the store unit to represent the first floor (30 by 100 feet; use $\frac{1}{8}$ - or $\frac{1}{4}$ -inch scale).
- Cut templates at the same scale from cardboard to represent the rooms or areas where primary operations are to be performed. These rooms or areas include the receiving platform, cooler, freezer, processing room, order assembly area, and shipping platform. The size of these rooms or areas can be estimated, based on the percentages in figure 4 and the turnover rate (p. 10). At this time estimate the size of each room or area; determine the exact dimensions later.
- Move templates about within the boundaries of the store unit drawing, giving consideration to area relationships established in step 3. Continue to make adjustments until an arrangement is made that provides a practical layout to satisfy the flow of products. (Step 4.)
- At the beginning, the arrangement of the templates for the first floor might look like the following figure:



Arrangement of templates for first floor.

- Draw to scale on a sheet of paper another outline of the store unit to represent the mezzanine.
- Cut templates to represent the space allocated to secondary areas such as offices, restrooms, a lunchroom, and packaging material storage.
- Move templates about within the boundaries of the store unit drawing, giving consideration to desirable area relationships.
- At the beginning, the arrangement of the templates for the mezzanine might look like the figure shown on the opposite page.
- Because of pallet dimensions, equipment requirements, or aisle space needs, the wholesaler later may need to change the size or shape of an area represented by templates. The changes may bring about compromises in the overall layout to conform with area relationships established in step 3.



Arrangement of templates for mezzanine.

PLANNING THE DETAILED LAYOUT

After the overall layout is developed (shown in steps 1 through 5), detailed planning for each area or room should begin. Details should comply with the U.S. Department of Agriculture's regulations governing the inspection of poultry and poultry products.⁵

Step 6. Plan the cooler. The cooler places the first limitation on volume that can be handled by this firm in a store unit.

- Determine the average volume of products to be stored (average inventory).
- Annual volume of ice-packed poultry handled _____ 6,300,000 pounds
Number of turnovers per year (step 1) _____ 156 pounds
- To determine average inventory of ice-packed poultry handled use formula shown on page 6.

$$\left(\frac{6,300,000 \text{ pounds}}{156} \right) = 40,385 \text{ pounds average inventory}$$
- Forecasted 10-year increase of 20 percent in volume (step 1) handled would add 8,077 pounds to average inventory.

$$(40,385 \text{ pounds} \times 20 \text{ percent}) = 8,077$$
- Estimated volume above average inventory is another 20 percent or 8,077 pounds. (This 20-percent-above-average inventory is the normal maximum inventory anticipated by the firm.)
- The cooler should be planned for a maximum storage capacity of 56,539 pounds of poultry.

$$(40,385 \text{ pounds} + 8,077 \text{ pounds} + 8,077 \text{ pounds}) = 56,539 \text{ pounds}$$
- 36- by 48-inch pallets will be used, each holding 1,560 pounds.
- Space will be needed in the cooler for 37 pallets.

$$(56,539 \text{ pounds} \div 1,560 \text{ pounds}) = 36.2 \text{ pallets}$$
- Space required for 37 pallets of product, stacked 1 pallet high, is 518 sq. ft.

$$(37 \times 14 \text{ square feet per pallet}) = 518 \text{ square feet}$$
- The firm plans to use a narrow-aisle forklift truck, so space for an aisle 7 to 8 feet wide will be needed in addition to the 518 square feet above. The aisle should provide clearance for all rows of pallets.
- As technological changes occur or a greater variety of products is handled, racks could be installed later to permit stacking pallets three tiers high. This will accommodate the anticipated new poultry products that can be high stacked.

⁵ Regulations Governing the Inspection of Poultry and Poultry Products. I
Marketing Service, Washington, D.C. 20250.

- Floor drains (three drains, 4 inches in diameter are suggested) with deep-sealed traps will be needed.
- The floor should be impervious to moisture and sloped ($\frac{1}{8}$ to $\frac{1}{4}$ inch per foot) toward the drains for an adequate runoff of water.
- Doorways should be at least 5 feet wide and 8 feet high to permit easy passage of forklift trucks and pallets.
- Approximately 780 square feet of floorspace will be needed in the cooler.

Step 7. Plan the freezer.

- Determine the average volume of products to be stored (average inventory).
- To determine the average inventory of frozen poultry products handled, use the same formula as in step 6 and the volume in step 1.

$$\left(\frac{200,000 \text{ pounds}}{40} \right) = 5,000 \text{ pounds average inventory}$$

- Forecasted 10-year increase of 20 percent in the volume handled would add 1,000 pounds to average inventory.
($5,000 \text{ pounds} \times 20 \text{ percent} = 1,000 \text{ pounds}$)
- Estimated volume above average inventory is another 20 percent, or 1,000 pounds.
- The freezer should be planned for a maximum inventory of 7,000 pounds of poultry.
($5,000 \text{ pounds} + 1,000 \text{ pounds} + 1,000 \text{ pounds} = 7,000 \text{ pounds}$)
- Shelves, rather than pallets, will be used in the freezer because small quantities of many products are to be handled. Based upon the weight and measurement of the packages of products to be handled, the products will be stacked 32 pounds per square foot of shelf space.
- Approximately 225 square feet of shelf space should be adequate for 7,000 pounds. Additional shelves could be added later at higher levels if the volume increased above expectations.
- A freezer 11 by 13 feet (approximately 140 square feet) with three shelves, $2\frac{1}{2}$ feet wide, will provide 225 square feet of shelf space.

Step 8. Plan the processing room.

- Equipment needed consists of a 3- by 8-foot table, cutters on a table (two powered circular knives), a scale, one 10- and one 16-foot conveyor, washing facilities for cleanup, and a sink with foot-operated controls for workers.
- Approximately 9 square feet of space should be provided for a work station for each of three employees.
- Floorspace should be provided for two pallets.
- Walls and doors should be impervious to moisture and be smooth finished.
- Floor drains (two drains, 4 inches in diameter are suggested) with deep-sealed traps will be needed.
- The floor should be impervious to moisture and sloped ($\frac{1}{8}$ to $\frac{1}{4}$ inch per foot) toward the drains for adequate runoff of water.
- Doorways should be at least 5 feet wide and 8 feet high to permit easy passage of pallets. The doors should be self-closing.
- Approximately 360 square feet of floorspace will be needed.
- A room $12\frac{1}{2}$ by 29 feet will provide adequate space.

Step 9. Plan the order assembly area.

- The order assembly area should have adequate space for assembling about 30,000 pounds of products per day.
($7,800,000 \text{ pounds annual volume} \div 260 \text{ work days} = 30,000 \text{ pounds}$)

This is about 20 pallet loads.

$$(30,000 \text{ pounds} \div 1,560 \text{ pounds per pallet} = 20 \text{ loads})$$

- Space should be provided for 20 pallet loads of product. Approximately 280 square feet would be needed.
(20 by 14 square feet per pallet = 280 square feet.)
- Additional space would be needed for an 8-foot-wide aisle through the area. Some of the product can be assembled on the shipping (front) platform.
- A floor drain (one drain, 4 inches in diameter is suggested) with a deep-sealed trap will be needed.
- The floor should be impervious to moisture and sloped ($\frac{1}{8}$ to $\frac{1}{4}$ inch per foot) toward the drain for adequate runoff of water.
- Approximately 450 square feet should be adequate for the order assembly area.

Step 10. Plan the shipping office and trashroom.

- A standing counter and a stool will be needed in the shipping office.
- The shipping office should have windows in the walls between it and both the processing room and the front platform for observation.
- Approximately 35 square feet of space should be adequate for the shipping office.
- Space will be needed in the trashroom for storing 1 day's accumulation (approximately 3 cans) of trash.
- A floor drain (one drain, 4 inches in diameter is suggested) with a deep-sealed trap will be needed in the trashroom.
- The walls and floor of the trashroom should be impervious to moisture and the floor should be sloped ($\frac{1}{8}$ to $\frac{1}{4}$ inch per foot) to a floor drain for adequate runoff of water.
- Approximately 40 square feet of space should be adequate for the trashroom.

Step 11. Plan the receiving and shipping areas

- The receiving and shipping areas (front and rear platforms) are fixed in size and location by the design of multiple-occupancy buildings. Two platforms, each 14 feet wide and 30 feet long (equal to the width of the store unit), should be adequate.

Step 12. Plan the packaging material storage area (dry storage area).

- Space will be needed for about eight pallet loads of materials and an aisle. This space can be on a mezzanine above part of the processing room, which would provide 300 square feet. A portable belt conveyor or the forklift truck can be used to move materials from the first floor to the mezzanine dry storage area.

Step 13. Plan the restrooms.

- The restrooms can be placed on the mezzanine. One toilet bowl will be needed for one to 15 employees of the same sex. One toilet bowl for each sex should be adequate for this firm.
- A locker should be provided for each production employee. Two tiers of lockers can be used.
- Each restroom should have one lavatory for each 15 people.
- Exhaust fans to the outside of the building should be provided for ventilation.
- The arrangement of the facilities in the restrooms will determine the size of rooms needed. Approximately 130 square feet of floorspace should be adequate for the two restrooms.

Step 14. Plan the lunchroom.

- The firm needs a lunchroom with space for about six people at any one time. The room can be located on the mezzanine.
- Space will be needed for a table-bench and food and beverage vending machines.
- Approximately 130 square feet of floorspace should be adequate for the lunchroom.

Step 15. Plan the offices.

- The firm needs one office for the bookkeeper and one office for the manager.
- Space will be needed in these offices for desks, chairs, filing cabinets, and any other necessary office furniture.
- Approximately 290 square feet of floorspace should be adequate for these offices.

Step 16. Summarize the floorspace needed.

- The rooms or areas of the store unit in this example should contain approximately the following amounts of floorspace:

First Floor:	Square feet
Receiving platform -----	420
Cooler -----	780
Freezer -----	140
Processing -----	360
Order assembly area -----	450
Shipping office -----	35
Trashroom -----	40
Shipping platform -----	420
 Total -----	 2,645
 Mezzanine:	
Packaging material storage (dry storage) -----	300
Restrooms -----	130
Lunchroom -----	130
Offices -----	290
 Total -----	 850

Step 17. On the store unit outlines made to scale in step 5 draw in the individual areas developed in steps 6 through 16.

- The shape and location of each area are shown; the correct amount of space for each area is used; door openings, aisle space, and equipment locations are shown.
- This becomes the final detailed layout for the store unit as shown in figures 5 and 6.

Step 18. Evaluate the layout.

- Does it satisfy the principles of good layout outlined on page 4?
- Does it satisfy the needs of the firm?
- Does it use space effectively? Can cubic space be used as future expansion area?
- To achieve good flow through the facility with the least amount of backtracking, are operations arranged in the sequence they occur?
- Do employees and materials move minimum distances?
- Has flexibility been considered by making as few permanent walls as possible?
- Has the safety and comfort of employees been considered by making aisles sufficiently wide, eliminating excessive walking, and providing an employee comfort area?
- Have all areas been integrated so that each contributes to making a good overall layout?

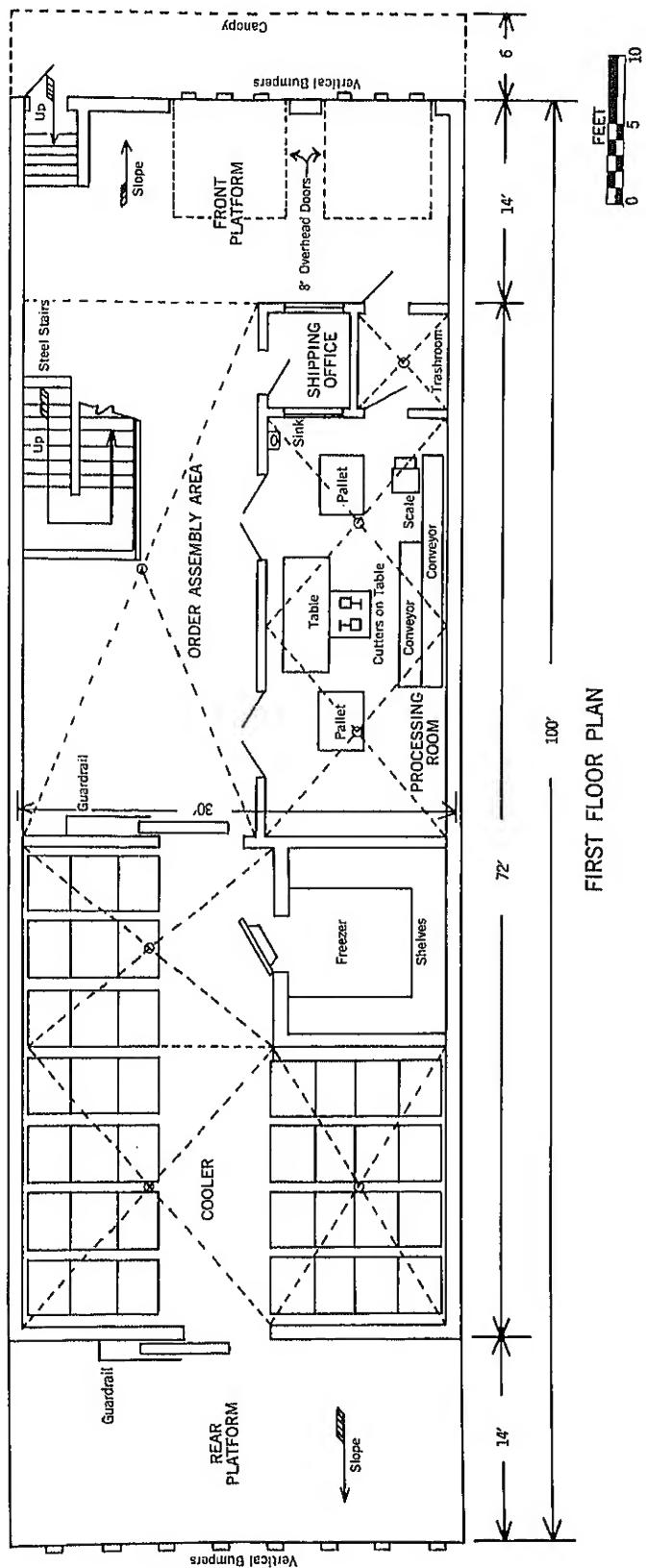


FIGURE 5.—Layout of the first floor for a poultry wholesaler in a multiple-occupancy building.

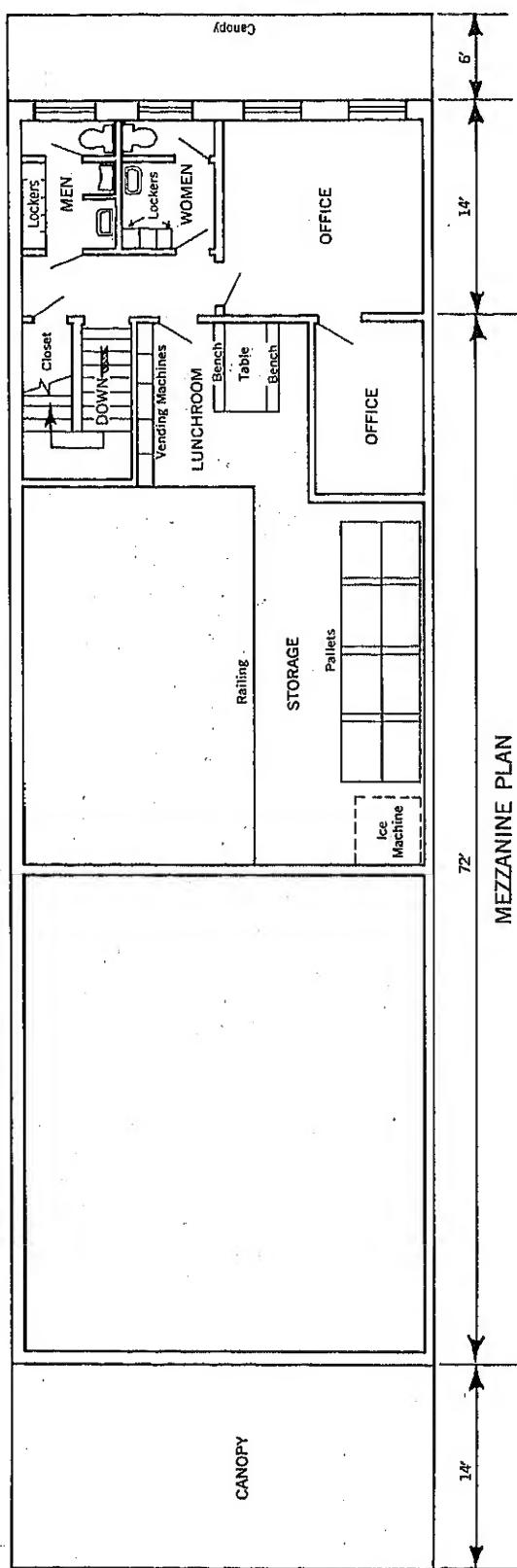


FIGURE 6.—Layout of the mezzanine for a poultry wholesaler in a multiple-occupancy building.

